

Passage Planning made efficient and cost-effective

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1. Abstract

The purpose of this paper is to describe how the Shell UK Coastal Fleet determined its criteria and principles for company-approved berth to berth passage plans within an electronic chart display system. Using PC Maritime's Navmaster Professional, Shell UK now has databases of waypoints and routes covering the whole of our trading area. The routes are used to generate passage plans in an approved format, comprising not just courses and distances, but also important procedural information.

Shell UK's objectives in this project are to increase safety and to ensure compliance with regulations.

2. Introduction

I have been in a position to oversee and assess Passage Planning from three viewpoints: as a seagoing Master, as one involved in development of the system, and as a member of a ship operator's management team carrying out vessel assessment.

In my duties as an assessor I have seen little development so far in electronic passage planning, with few plans complying fully with M Notice 854.

In introducing electronic chart display systems to our fleet one of our objectives was to provide electronically stored berth to berth passage plans for all regular routes, and I was given this task, in consultation with all senior masters.

A large proportion of this task has been completed. 5 databases are now available covering Shell UK's trading area, divided into 5 geographical areas totalling 2050 waypoints. Routes using these waypoints can be created on board as required. Originally approximately 1850 routes were identified but anticipated development of the Navmaster system will reduce this to fewer than 300.

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The routes are easily selected and when a departure time and estimated speed are entered into Navmaster Professional they generate a passage plan in an approved format.

3. Background

Shell (UK) Ltd operates a fleet of four owned coastal tankers of 3,000 dwt, plus a number of chartered vessels. The ships transport various refined petroleum products for commercial and domestic use to a wide range of ports around Britain, Ireland and Northern Europe.

In 1996 we purchased five Navmaster Professional Systems, each with about 200 ARCS chart licences. One set was fitted to each ship and the fifth system is for use by superintendents in head office. Apart from ARCS compatibility, we selected Navmaster Professional because:

1. It had good ARCS chart management.
2. The workload of ship's staff could be reduced and quality of chart correcting assured by an electronic method of updating.
3. It provided a position indicating system in a format easily recognised by Navigating Officers.
4. It was PC-based, operated in Windows™, and was easily adapted to ship's existing equipment.
5. Its potential for ensuring fleet compliance with passage planning was recognised.

4. Shell UK's Passage planning criteria

The main reasons for having company-approved routes are to increase safety and to ensure compliance with regulations. There are also additional benefits of improved efficiency and timesaving onboard. These were our criteria:

1. To ensure that all Coastal Fleet vessels **follow routes considered safe** by the Management, and that passages and channels considered unsuitable are avoided. [**Safety**]
2. To ensure that a **risk assessment** of each route is carried out at Head Office level thus meeting ISM requirements. [**Safety and Compliance**]
3. To ensure that all vessels **comply with current rules and regulations** concerning routeing and reporting and that local directions for ports are met. [**Compliance**]
4. To provide the means to **monitor vessel position** and progress. [**Safety**]

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5. To enable all vessels to have approved routes from **berth to berth** so that Masters do not need to supervise navigating officers in their preparation. [**Efficiency**]
6. To provide automatic **access to notes** for the route and waypoints when passage-making. [**Safety**]
7. To ensure that the **knowledge and experience** of the Company's and other shipowners' masters, gathered over many years, **is available to all personnel** in the fleet. [**Safety and Efficiency**]
8. To provide for changes in routes to be incorporated into the database immediately, and all vessels issued with updated routes to ensure **conformity** throughout the fleet. [**Safety and Efficiency**]

5. Rules and considerations in constructing routes

I used the following guidelines when considering our routes (at the time of compiling the routes, ISM accreditation had not been attained).

1. Is the route prohibited by HO Rules and Regulations?
2. Is the route contrary to any IMO or DTp guidelines?
3. Is the route environmentally sensitive?
4. Is the route politically sensitive and are there local considerations?
5. Is the route risk assessment to be regarded differently whether a vessel is loaded or in ballast?
6. Does the fleet traditionally use the route? - If so have any incidents occurred previously? - A risk assessment matrix is to be followed for any section of a route which would not comply with the basic minimum requirements of safety which had been determined.
7. Is it in line with all procedures which could be envisaged as ISM requirements?
8. If the previous items are not applicable or do not exceed normal or expected risks within the marine environment and operation then the following minimum requirements should apply:

All vessels:

1. All rules and regulations, HO, Port, local, and DTp., to be complied with. All TSS's to be followed.

Loaded vessels:

1. In general, the minimum margin of safety from any coastline should be 3 miles. Provision should be made in any instructions to enable Masters to increase this distance if they so wish, such as in adverse weather, but not to decrease it.

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2. The distance of 3 miles will be increased if the coastline has any off-lying danger, to 3 miles off such danger.
3. The standard distance of 3 miles will also apply to what may be termed the grounding line. This is the contour line indicating depth at which the vessel may be considered at risk from grounding at her present draft and in the prevailing conditions of sea and swell.
4. The distance off the grounding line may be reduced if:
 - a) The area is not generally considered to be exposed to severe states of sea and swell.
 - b) There is an anchoring depth between the vessel and the grounding line.
 - c) The grounding line is marked by navigational marks.
 - d) The vessel is in a recognised pilotage area, and the Master is conning the vessel, or a Pilot is on board.
 - e) The vessel is in an increased state of readiness, with main engine on standby and increased bridge manning.
 - f) The route is the recognised passage for the area in order to reach a port, or to transit a particular channel.
 - g) A tidal window dictates that in order to reach a berth the vessel has to cross an area which would not be of sufficient depth at Chart Datum.
5. In any situation, unless in a recognised port or pilotage area, the distance off the grounding line, whether a marked or unmarked danger, should never be less than 1 mile.
6. Any passage plan indicated as being preferred by HO has to be suitable in any normal circumstances, relying on the Master of the vessel to make any adjustments as he sees fit depending upon the immediate situation. For this reason, the grounding line for the majority of passages and sea and swell states should be considered to be 10 metres. This should be increased to two and a half times the draft on exposed passages such as the West coasts of Ireland, Western approaches to the English Channel, and Northern Scottish coasts. Isolated shoals less than a depth of 18 metres which appear to give a safe margin but which can cause overfalls and breaking seas in conditions of heavy swell will be given a safe passing distance of at least 1.5 miles.
7. Isolated dangers are treated on an individual basis, but the minimum safe passing distance for a marked isolated danger should be 1 mile, and for an unmarked danger 1.5 miles.

Ballasted vessels:

1. In general Oil Tankers in ballast, apart from the obvious hazards of fire and explosion are not perceived by marine industry personnel to pose any greater pollution risk than other vessels. There is a tendency to consider some routes as acceptable in ballast but not when loaded, and it is sometimes considered that different criteria govern the choice of route followed by a tanker in ballast. The point of view taken by our management however is that there is the risk of a loss of asset, i.e. the vessel. As matters stand at present there are no rules and regulations prohibiting certain passages if the vessel is in ballast. Previous guidelines used in formulating passage plans preclude the use of certain routes only when the vessel is loaded. Furthermore, some Masters argue that use of certain passages enables vessels to save time and execute their voyages more efficiently.
2. Due to the main consideration being the loss of the ship when in ballast, and the fact that no route should be followed primarily for commercial considerations, Loaded and ballast passages would be subject to identical criteria.

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6. Project procedure defined

The foregoing considerations resulted in the following draft procedure for the project:

1. The purpose of this document is to ensure that the Shell UK Downstream Oil Coastal fleet has a universally agreed set of passage plans for use in pursuing its voyages.
2. Passage plans will cover each voyage in full from berth to berth.
3. All passage plans are to be approved of, and issued by Head Office.
4. Ship's Masters are empowered to deviate from any passage plan. However, any such deviation must first be agreed with Head Office. In cases of emergency, or where Head Office cannot be contacted, the Master must record and give his reasons for them.
5. The Passage Plans will be provided in the form of a CD-ROM ~ (electronic form)~ for use within the Navmaster system. Head Office will control all amendments. There will be a facility within the ISM / SMS for suggested amendments from vessels to be implemented.
6. Passage plans where appropriate will include information sufficient to comply with all Company requirements contained in Regulations and Instructions, and also all recommendations in DTp publications, particularly M. Notice 854.
7. In deciding upon routes to be taken, due regard will be given to the fact that each passage plan must be suitable for all occasions, in all conditions which can normally be expected in the trading pattern of the fleet, and in normal weather and sea conditions for each area. For this reason all routes and passage plans will be formulated on that basis. Any routes which are considered suitable only in ballast condition or in fair weather will be designated as such. Masters are responsible for ensuring that each route is suitable for the conditions prevailing at the time the passage is undertaken, and to make such deviations as they see fit.

7. Supplementary Instructions & Notes to the Routes

In constructing the routes in Navmaster Professional the following are included in narratives accompanying the passage plan:

1. A minimum Chart datum depth to be expected on each passage will be given.
2. Areas considered to be Pilotage waters where the Master, an area license holder, or a Pilot should be on the bridge will be indicated.
3. Navigational marks to use when navigating visually near a waypoint indicating an alteration of course should be pointed out.
4. No alteration should be indicated in such a way that the GPS default warning of vessel being off course or off track is not activated before the vessel runs into danger if the alteration is missed.
5. No alteration of course should depend upon a position obtained by electronic means. Visual verification must always be available.

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6. A suggested setting for the GPS / Decca cross track error for each leg should be included in the plan.
7. Each phase of the passage should include a suggested time interval setting for the Bridge watchkeeping alarm.
8. Areas where it is considered that the Engine room should be on an increased state of readiness should be indicated.
9. No waypoints other than those involved in navigation should be entered in a database visible on the chart. Information points should be included in a separate database to avoid mistaken use of such waypoints when the Master is plotting an alternative route using Navmaster.
10. If on passage, a single course line is to be followed for any length of time, an additional waypoint should be included to warn the OOW to check the GPS and his position by visual means.
11. This should also be done when approaching restricted areas from open waters.

8. The benefits and considerations for the Master

The Master's responsibility with regard to passage plans is to ensure that all safety and Company requirements are met, and that the plan is followed accordingly. When a Company approved route is being followed the Master can assume that all regulations and general considerations have been met.

However, following an approved course does not of itself ensure that all current navigational hazards have been anticipated, and the Master will still have to ensure that all navigational warnings are received. Weather conditions may dictate a departure from the approved route and tidal windows may require changes to be made to the passage plan.

Masters are entitled to deviate from the route should they consider it necessary. However, reasons for such deviation would have to be given, and Head Office informed. The only exception would be deviations which might be advised in a passage plan, for instance when notes accompanying a waypoint advised the Master to follow a course further offshore in severe weather etc. or in cases of emergency.

In the present climate of checklists, procedures and other ISM related tasks, and the problems in many fleets where there is such a rapid turnover of personnel that the Master may be unable to

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assess an individual's ability to formulate an acceptable passage plan at short notice, a ready-made plan complete with appropriate checklists may be essential.

A checklist for the Master to use when compiling or approving a passage plan is given in the Appendix. This list has been incorporated into Shell's customised version of the passage plan produced by Navmaster.

9. Anticipated Problems

1. Resistance from Masters. The main objection to passage plans created by Head Office is from Masters who feel that their authority and decision-making powers are being undermined.
2. Resistance by OOW's. Changes in routes means changes to all vessels routes on paper charts and complete replotting of course lines. This consideration will disappear when full ECDIS is used.
3. Risk of out of date information being used. Successful guardianship will counteract this risk.
4. Complacency, particularly in bridge watchkeeping situations where electronic plotting is being used. Training needs to cover this.
5. Duplication of effort during the transition period dealing with the requirements of both paper and electronic charts.
6. Cost to the Company if duplication of chart supply (electronic and paper) was prolonged during the transition period to full ECDIS.
7. New GPS equipment may be required to handle the number of waypoints making up a route
8. Our current GPS equipment cannot import routes from the charting system as an entity. They will only import the sequence of waypoints which then have to be joined together.
9. Numerous technical problems would obviously arise, and did, but were generally dealt with successfully.

10. Training

Of great concern to Masters in the present regime of reliance upon electronic aids to navigation is to ensure that navigating officers are aware of their limitations. The problem of passage plans being regarded as sufficient if they consist only of a series of waypoints without any narrative is that many compatible GPS's accept a series of waypoints and display them on the radar screen as a route in the form of a line to be followed on the radar screen. In an area where there are no easily

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recognised visual navigational aids, errors can be made in following the ‘dotted red line’ even when a vital waypoint may be missed. Training, OOW awareness, Master’s standing orders and the inclusion in the route of waypoints which alarm simply by ‘being there’ and alerting the OOW to check his position before a hazardous area is entered can all help to alleviate this problem.

Training is the biggest ongoing problem with any electronic chart system due to relatively few OOW’s having had experience of such systems. The training regime must never be regarded as being completed. Ongoing training is required due to both turnover of personnel and new versions of programs being issued.

11. How Navmaster handles the data

In Navmaster Professional, waypoints and routes are stored in separate databases. Any number of waypoint databases can be created each containing any number of waypoints. Each waypoint can have additional information attached in pre-defined fields.

Similarly any number of route databases can contain any number of routes with additional information in pre-defined fields as shown in Table 1.

11.1. Creating waypoints

Creating waypoints is straightforward. The user can point to a position on screen and post that position into the waypoint database. He can enter additional information into the fields now or later.

Waypoints	
Field	Type of data
Name	Text
Area	Text
Type	Text
ID	Alphanumeric
Zone time	Number
Lat \ Long	Up to 4 decimal places
Datum	Automatically recorded
Memo	Up to several pages of text
Attachments	Up to 3 bitmap images and 1 video clip
Routes	
Name	text
From	text
to	text
Memo	up to several pages of text
Attachments	up to 3 bitmaps and 1 video clip

Table 1 Navmaster waypoint fields

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11.2. Criteria for Waypoint Position

Navmaster Professional provides aids for easy positioning of waypoints, including a graphic deviation limit to display, for example, the minimum safe passing distance from an unmarked danger.

Unless directional waypoints are used, all waypoints should be usable in any direction, except within TSS's, to avoid duplication and excessive

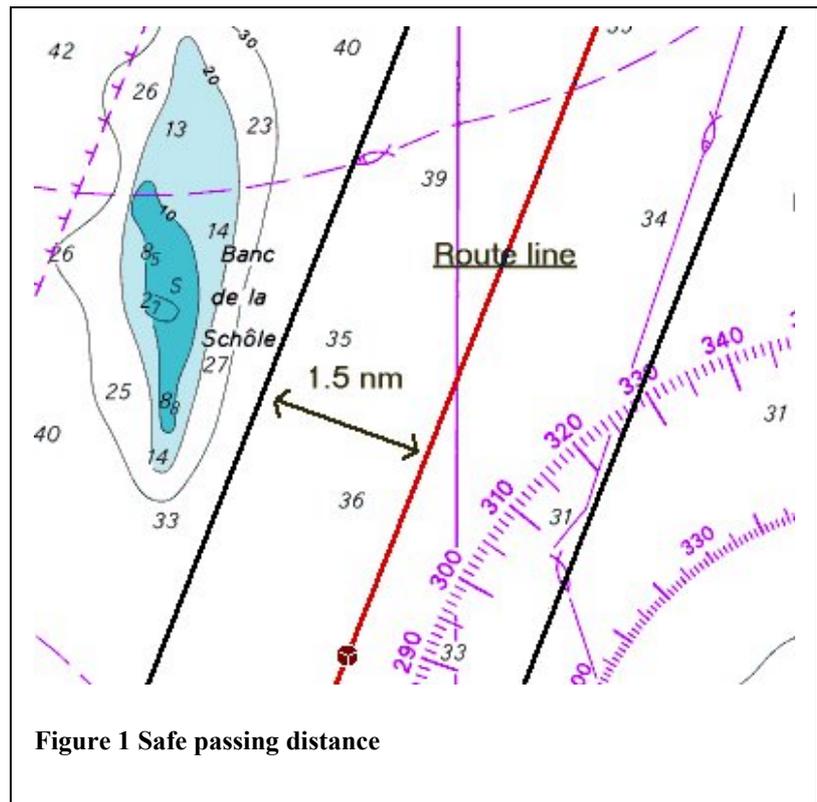


Figure 1 Safe passing distance

numbers of waypoints. For instance, in its simplest form, FAOP and EOP positions will use the same point, but an abort point would only be used in the direction of travel.

Name, Area, Type & ID

These fields are provided by Navmaster Professional and the reasons for them are largely self-explanatory. The database can be sorted by any of these fields to make route waypoint selection easier. Examples of the types defined by Shell UK are given in Table 2.

Memo

Navmaster Professional's memo field will take up to several pages of text which can be printed on the passage plan as shown in Figure 2.

Textual information must be sufficient to meet the requirements of M Notice 854 and associated publications.

<p>Types of chartpoint. General Information. FAOP (full away on passage) EOP (end of passage) Directional. Abort position Check position indicator Vessel status indicator Alter course position Pilot station position Reporting point Option to act position Anchorage Standing Orders reference position</p> <p>Table 2 Shell UK "Types"</p>
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23	WGS84	04:41:01	000:11:28	JERSEY FAOP \ EOP	49°10.34'N
		15/03/1999			002°18.18'W
Memo					
1. FAOP AND EOP					
2. LA CORBIERE BRG 078 X 2.1'					
3. INWARD BOUND FOLLOW RECOMMENDED TRACK 095					
NORTH OF BANC DE ST BRELADE					
4. NOIRMONT POINT WILL BE ALMOST IN LINE BRG 095					
5. HARBOUR CONTROL ON VHF CHAN 14					

Figure 2 Memo field displayed in passage plan

Visual information

Navmaster Professional offers the ability to attach several images and a video clip to waypoints. This facility can be used for a variety of purposes, with the most obvious being to provide pilotage information and a visual reference to locations. This is a very accessible technology made increasingly popular by the growing use of digital cameras on board ships. An example, provided courtesy of Navitrom Ltd¹, is shown in Figure 3.

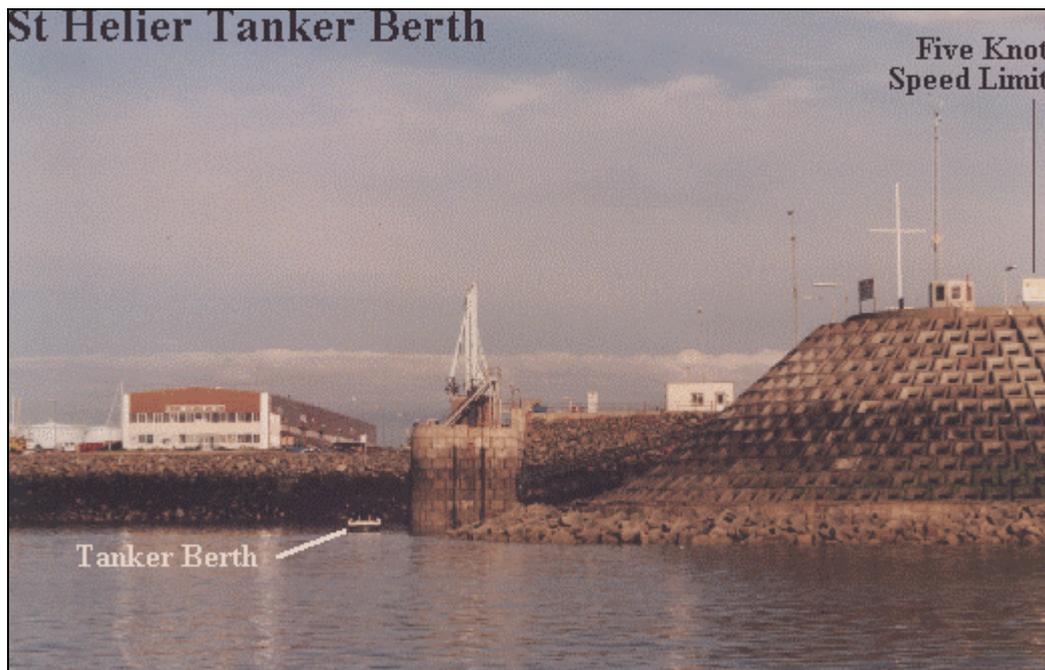


Figure 3 St Helier tanker berth

¹ Navitrom, a Jersey based company, have created pilotage waypoint and route databases for use with Navmaster Professional.

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11.3. Defining routes

When the waypoints have been defined, routes can be created by clicking on each waypoint symbol on the chart, or by selecting them from a list. The waypoint list can be sorted by latitude, longitude, name, area or type (enabling, for example, those in a specific area to be displayed together). As each waypoint is selected, it is included in the route waypoint list and a connecting line drawn on the chart. Route waypoints can be inserted, deleted and moved as required by simple on-screen actions.

The data attached to waypoints is automatically carried over to the route waypoints ensuring that information is consistent across routes using the same waypoint.

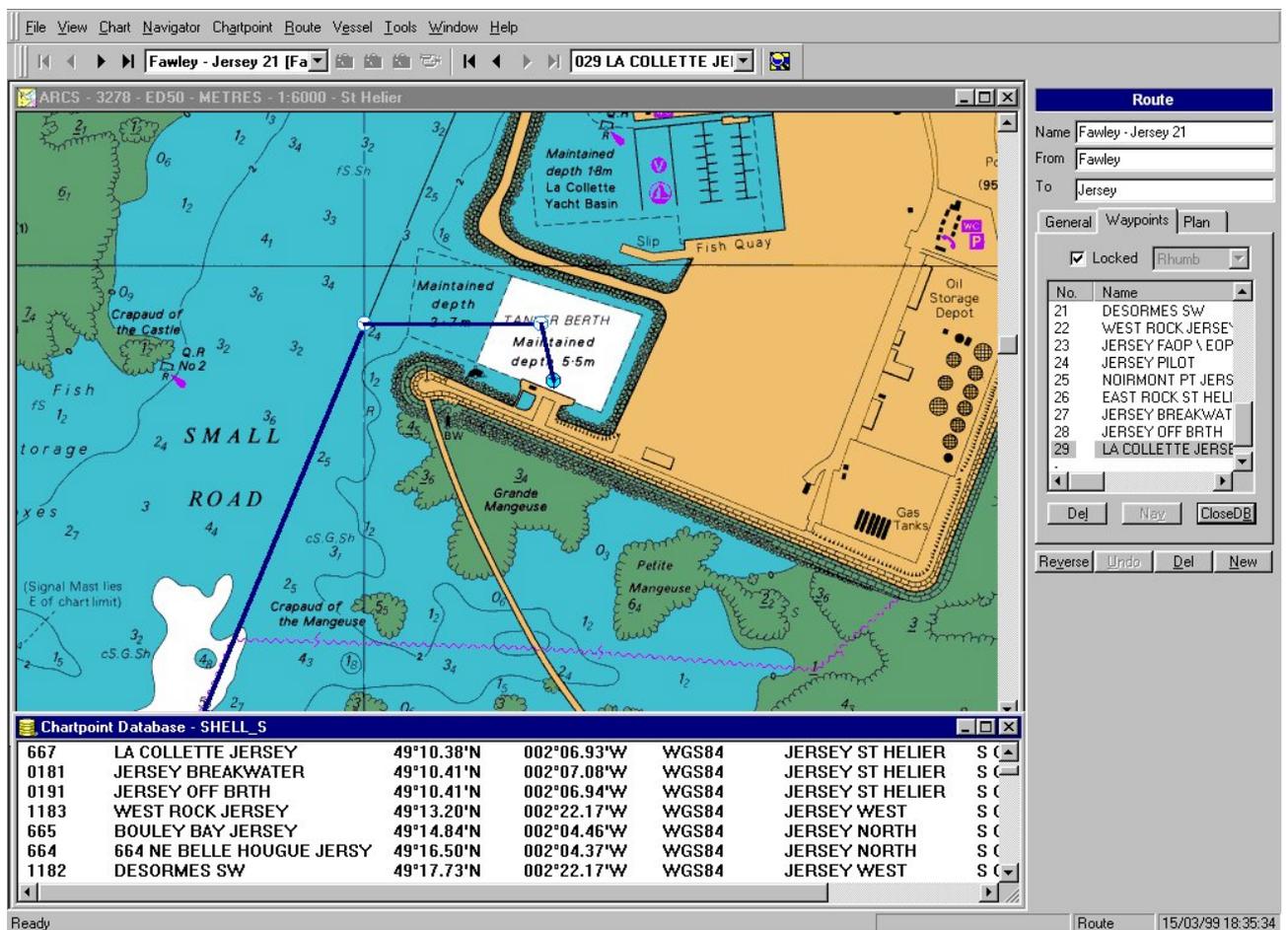


Figure 4 Building a route from pre-defined waypoints

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11.4. Producing a passage plan

Shell UK Ltd
Coastal Operations Department



Passage Plan Report

FROM : Fawley
TO : Jersey

<p>Vessel : <i>Achatina</i> Estimated speed : 12.0 knots Passage distance : 145 nm Passage time : 000:12:07 Route name : Fawley - Jersey 21 Passage plan name : Untitled</p>	<p>Options : Tides [Off] Variation [Off] Deviation [Off] Calculated : 16:17:23 15/03/1999 Viewed : 16:17:38 15/03/1999</p>
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Memo
Ensure report to Joburg Traffic . Via south of Ryde, middle and east entrance to Solent.

Rte Wpt No	Datum	Time	Elap Time (ddd:hh:mm)	Name	Position	Crse (°T)	Leg (nm)	Accum (nm)	To Go (nm)
1	WGS84	16:00:00 12/04/1999	000:00:00	OFF FAWLEY JETTY	50°50.15'N 001°19.28'W	142	0.91	0.00	145
Memo HAMBLE POINT BUOY BRG 090 X 4 CABLES									
2	WGS84	16:04:33 12/04/1999	000:00:05	HOOK BUOY OUT	50°49.43'N 001°18.40'W	139	0.42	0.91	144
Memo REPORTING POINT HOOK BUOY BRG 036 X APPROX 1.3 CABLES									

Figure 5 Navmaster's passage plan layout, customised for Shell UK.

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The first step to take to produce a passage plan is to select a route from a drop down list, which enables the user to scroll between all available routes. When a new route is selected, it is drawn with waypoints and legs displayed on the chart. The departure time (or desired arrival time) and estimated speed for the passage are entered as shown in Figure 6.

Once these details are complete, pressing a button calculates the plan and gives the option to print or view the plan.

An example of the Navmaster's passage plan layout is given in Figure 5. The layout can be customised to meet the requirements of specific users.

11.5. Maintenance

The quantity of data required for all the waypoints and routes used by the fleet quickly becomes significant and therefore maintenance and updating becomes an issue. It is important to designate a "system guardian" at line management level who is responsible for ensuring that changes are incorporated into the databases and distributed to the fleet.

The weekly Update CD produced under the ARCS system provides the source for identifying waypoints sited in an area where there has been a chart correction. The ability to display the sections of the chart which have been updated is an important attribute of Navmaster Professional in this respect. When a waypoint is changed, each route using it has to be updated.

Masters must also become local system guardians, by drawing Head Office's attention to navigational warnings and changes that affect the routes.

Updated waypoint and routes will be issued to the fleet on CD-ROM.

12. Demonstration Route

The route from the EC1 buoy in the English Channel to Jersey illustrates many of the considerations required of a passage plan as discussed in this paper.

Figure 6 Passage plan parameters

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1. From EC1 the Master is given the choice of crossing traffic entering and leaving the traffic separation scheme from a position which he considers safe and where he is able to comply with Rule 10, crossing at right angles, with allowance for tidal set.
2. A warning is given to contact the French Authorities.
3. Parallel index (PIX) distances and landmarks are given.
4. Warnings of strong tidal streams in the area are given.
5. The presence of hidden dangers - e.g. Banc de la Schole will be indicated.
6. For OOW's inexperienced in navigating in the area, warnings such as those given for tidal sets to be expected off the Desormes buoy are useful.
7. PIXes off Jersey will be indicated. Also alternative anchorages - e.g. Beuley Bay.
8. Appropriate bearings and distances to radar targets and headlands will be given.
9. Waiting areas will be indicated. This area may also indicate an initial abort position, or a bridge status requirement or status of engine room requirement as dictated by Head Office.
10. EOP / FAOP positions indicated; VHF channels for Port and Pilots indicated.
11. The recommended track to be followed can be emphasised, with suitable leading marks.
12. Pilot boarding positions will be indicated.
13. Anchorages will be indicated, accompanied by warnings of any limitations.
14. Clearing distances off Noirmont point will be given, with a warning of strong tidal streams.
15. Leading marks will be noted, and contingency plans made available. The tidal levels required to berth will be indicated. In the case of Jersey a warning is required for tidal levels that are too high to berth, requiring a wait for another tidal window. E.g. There may be sufficient water to berth at the start of the tide, but the height increases to a level where the causeway will cover and there will be too strong a tidal set to the north to allow safe berthing.
16. An abort position will be indicated where the Master must decide whether or not to carry out the final approach. Due to the restricted area off the berth, this is the final abort position marked, but each Master would be aware of the actions he would take should an unforeseen event occur between this point and the berth.
17. General manoeuvring procedures for berthing will be shown.

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18. Properties of the berth, including hazards alongside - e.g. ranging, and order of moorings will be indicated.

13. REFERENCES

DTP M Notice 854 Navigation Safety.

International Chamber of Shipping Bridge Procedures Guide

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14. Appendix

A draft passage plan checklist to be appended to each Navmaster passage plan is shown below.

PASSAGE PLANS - ITEMS TO INCLUDE		
<i>MASTERS STANDING ORDERS</i>		
General passage description		
Charts	All charts - electronic and paper in order?	
Safe Distances	Minimum Company requirement complied with?	
PIXes	Sufficient for all landfalls and headlands?	
Setting GPS for Cross track	Areas on passage where these are required?	
U.K.C.	Sufficient? - Are there any tidal windows?	
Tidal windows	Are all tidal windows under Pilotage or in Port	
Tidal streams	Any strong sets to warn of in Standing Orders?	
Navigation dangers	Are the latest Navigation warnings referred to?	
Rules & Regs - ALRS Vols Coastguard / CROSMA	Update all reporting requirements - It is assumed that Company routes follow the correct TSS's	
Radar targets	Use to check GPS positions - Use as PIXes	
Landfall lights	Check GPS and identify for PIXes	
Buoyage	Buoys with useful properties identified-e.g. Racon	
Echo sounder / soundings	Ensure areas in which this is to be used are noted	
Transits	Identify on paper and electronic chart notes	
Clearing marks	As for transits	
Position fix period	Ensure maximum time intervals stated in S. O's	

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Reporting points	Both charted and in ALRS (e.g. Coastguard)	
Pilot boarding areas	Charted and alternative positions	
Commence Port approach Position	Master on bridge - increased level of preparedness - Engine on Standby (EOP?)	
Abort point	Port / Channel / Berth Approach - Mark on chart	
Contingency action	Master to identify - OOW to be aware	
Port regulations	Latest changes in these items identified	
a/c warning if after mark	Use if a/c mark is 'aft of the beam'	
Status of Bridge	Standing Orders to give instructions on this	
Status watch alarm	Time interval setting to be stated	
Status E.R.	On standby at designated times and areas	
Areas of allowed deviation	E.g. awaiting pilot / slow steam / await daylight	
Banned areas	Marked on chart and assumed covered by HO	
Warning of Electronic glitches	Anecdotal or experienced on previous passages	
Details of ARPA maps	Identify those available for use on passage	
Waiting areas / courses	Identify and specify limitations	
Recommended tracks	Ensure these are followed - HO courses	
Traffic & type to expect	Master's Standing Orders to cover this matter	
Radio stations	Covered in the narrative	
Rules of the road	Ensure OOW's appear sufficiently experienced	
Anecdotal Information	Previous passages and experience.	